REPORT

ON

PEMBERTON VALLEY

RECLAMATION

August 10, 1945

BURNETT AND Mc GUGAN

ENGINEERS & SURVEYORS

NEW WESTMINSTER, B.C.

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Hon. George Spence, Esq.,
Director,
Prairie Farm Rehabilitation,
REGINA, Sask.

Dear Sir:

Foreword.

The writer, accompanied by your Gordon MacKenzie, visited the Pemberton Valley, arriving there on November 27th, 1944. At this time A.B. Cook, of the Prairie Farm Rehabilitation was in the Valley in charge of a party making a complete topographical survey of Lillooet River between Lillooet and Tenasse Lakes, as well as of the lower end of Tenasse Lake.

Again we visited Pemberton for a further inspection, arriving there on March 2nd, 1945. At this time J.C. Moore, of the Prairie Farm Rehabilitation was in the Valley in charge of two parties, making complete topographical surveys of that portion of the Pemberton Valley roughly from Green River to Lot 168 at the North end of the district.

We have also had available, all the records and plans of an extensive and complete survey of this valley from Lillooet Lake to a point between Miller and Ryan Creeks, made in 1913 by Cleveland and Cameron of Vancouver.

In addition to Cleveland and Cameron's report, we have reports by B. Russell in 1939, A.B. Cook in 1945, both of the Prairie Farm Rehabilitation, and G.M. Downton of Victoria, B.C.L.S. in 1919, all dealing with the drainage and reclamation of the Valley.

Purpose of Investigation

The purpose of these visits and surveys was to secure information required upon which to base a report of reclamation, outlining the probable degree of reclamation, the methods to be employed, the probable extent and success of these methods, the cost involved in the work and the cost per acre of such expenditures.

General

Lillooet River is a tributary of the Fraser River and heads in the mountains about sixty miles Northwest of Pemberton, a small town on the Pacific Great Eastern Railway. Pemberton is some fifty miles to the Northeast of Squamish on Howe Sound, B.C. Lillooet River flows Southeastwardly through a fertile valley, and passes under the Pacific Great Eastern Railway steel bridge one mile Northeast of Pemberton. At eleven miles Southeast of the bridge it empties into Lillooet Lake, - a deep lake 15½ miles in length and averaging three quarters of a mile in width. From Lillooet Lake to Tenasse Lake the river is confined to the East side of the valley by a large delta created by Portage Creek, a very steep mountain stream, which flows in from the West. This delta is composed of gravel, both fine and coarse, and boulders weighing up to 1000 lbs. The bed of the river now is rip-rapped with boulders of this size, so that even with the large fall no erosion is taking place. During high water there is a fall of 15½ feet between these lakes.

All former reports maintain that the widening and lowering of this section of the river between the two lakes is the first step in any program dealing with the reclamation of the valley above Lillooet Lake. Below the delta of Portage Creek the channel widens out into Tenasse Lake, the upper part of which attains a maximum width of 4000 feet and a maximum depth of 150 feet. At a distance of 1½ miles the channel again narrows to a width of 500 feet for a distance of 2/3 miles, and then opens into Lower Tenasse Lake for a distance of approximately two miles. At the outlet of Lower Tenasse Lake there still remain signs of a timber crib dam, built during the old Cariboo Trail days, as this formed part of the old road from New Westminster to the town of Lillooet on the Fraser River. From this point the river continues Southeast at a grade of over twenty feet to the mile through a rocky channel into Harrison Lake. This lake extends 40 miles, still in a Southeasterly direction to Harrison River, and thence to an outlet into the Fraser River at a point about 60 miles East from New Westminster.

The course of the Lillooet River is through heavily timbered mountainous country. In its 30 mile course through the Pemberton Meadows, and the Indian Reserve above Lillooet Lake, the river falls 120 feet. The average high water level of Lillooet Lake is at 655.0 feet elevation, Tenasse Lake at 639.5 feet and Harrison Lake at 34 feet, all elevations referred to Geodetic Datum.

A committee of six residents of the Pemberton Valley, with headquarters at Pemberton, have been very active for some years, in an effort to discover some means by which the rich alluvial soil of the district could be improved to allow 100% development. They have gathered together a great deal of local information, referring to the river, the amount of land at present cultivated and historical data. All of this has been freely made available to us.

At the moment all cultivation is confined to ridges on the banks of the Lillooet River or sloughs from the River. Throughout the years each overflow of the river deposited some extra silt on the banks, the heavy silt falling first and the light last. These deposits made high strips of land along the river which are only flooded occasionally, and which have good drainage at all times of the year. These strips chiefly comprise the cultivated areas of the Valley. They are very fertile, producing potatoes, turnips and other vegetables in very fine quality, and which at all agricultural fairs take many of the prizes. They are also productive, as average yields of 10 to 12 tons of potatoes per acre and 20 tons of turnips per acre amply testify.

Gauging Stations

Following is a list and description of gauging stations in the Lillooet River Drainage basin:-

1. Lillooet River near Pemberton

Location:	On the Pacific Great Eastern Railway Bridge 3/4 of a mile Northeast of Pemberton.
Gauge:	Chain
Drainage Area:	800 square miles
Discharge measurements:	Made from Highway Bridge 1½ miles above gauge
Records available:	November 1913 to September 1918 and April 1923 to September 1940
Extremes of stage recorded:	Maximum July 19, 1918 - 20,900 sec.ft. Minimum Feb. 1, 1933

2. Green River near Pemberton

Location:	Above Nairn Falls, 5 miles from mouth
Gauge:	Recording
Drainage Area:	200 square miles
Discharge measurements:	Made from cable carrier
Records available:	November 1913 to January 1922 May, 1922 to July 1922 and October 1922 to September 1940
Extremes of stage recorded:	Maximum October 28, 1938 - 7.30 p.m. (G.H. 14.50) 13,300 sec.ft. Minimum February 9, 1937 (ice) 95 sec.ft.

New Extreme Flood Records, October 1940

Mr. C.E. Webb, District Chief Engineer of the Dominion Water and Power Bureau, Vancouver, kindly forwarded the daily and monthly discharge records for the climatic years 1936-37 to 1942-43 for the above two rivers, also the discharge table for the Lillooet River, rating being applicable from high water August 14, 1943 to date. These later records show a new maximum flow of 31,800 sec.ft. in Lillooet River, October 19, 1940 and a new maximum flow of 14,200 sec. ft. in the Green River, October 19, 1940. At this time water covered the whole width of the valley in several places and washed several buildings down the river.

At high water on September 11, 1944, the chain gauge at the P.G.E. Railway bridge over the Lillooet River near Pemberton, registered 9.95 feet and this gauge height rates a discharge of 14,525 sec.ft. Therefore the 20 high water points set on September 11th represent a fairly high water gradient for this river. The above gauge height of 9.95 feet corresponds to an elevation of 684.0 feet (Geodetic and Cook) or 784.0 feet (Cleveland and Cameron). The high water level, Stake #20, of Lillooet Lake on September 11th was found to be 652.6 feet (Geodetic) or 2.4 feet below the average high water level of this lake.

Subdivisions of Report

A consideration of the reclamation of the Pemberton Valley naturally divides the area into four portions, as follows:-

Area No. 1 - From Lillooet Lake to Green River
Area No. 2 - From Green River to Miller Creek
Area No. 3 - From Miller Creek to Ryan Creek
Area No. 4 - Above Ryan Creek

Area No. 1

Lillooet River between Lillooet and Tenasse Lakes

In considering the reclamation of Area No. 1 above, being the area from Lillooet Lake to Green River, the method that gives the greatest assurance of success is to lower the elevation of Lillooet Lake, both at its high and low stages. This method was first recommended by Dr. E.A. Cleveland in his report in 1914. The following is a portion of his report:-

"Careful investigation has been made as to the probable cost of the required excavation of the channel between Lillooet and Tenasse Lakes and below Tenasse Lake. It appears likely that the method to be adopted for this work will be by donkey engine and scraper working directly across the channel. Not only is this method likely to prove more satisfactory in this heavy material than any form of dredge, but the cost of equipment and the expense of conveying it to the site will be much less."

"While the results of our tests of the river bottom with pipe rods indicated gravel and boulders, they do not furnish complete data, nor can it be obtained except at considerable expense. Careful observation seems to indicate that nothing more difficult than these materials will be encountered except possibly occasional buried snags or logs."

"Should the material prove not unduly heavy, it is possible that something less than 360,000 yards would need to be excavated, the current itself removing much of the lighter material in the ridges between the cuts made by the scraper."

"The result would be the reduction of the flood level of the Lillooet Lake by about 8 feet and the immediate scour of the River channels above to the first obstruction in the form of a submerged jam, if any. Upon its removal the scour would continue, thus forming a new hydraulic gradient for the River. This would certainly prove effectual in preserving the lower part of the valley, composed largely of Indian Reserves, from the damaging effects of high water, and would provide for drainage during the period when it is most required."

"Its effect on the lands several miles up the River is more problematical, owing largely to the considerable number of channels and the probable reasons for their formation, viz: submerged jams."

Complete new surveys have been made of the Lillooet River between Lillooet and Tenasse Lakes, including sections every 100 feet practically along its entire length. In addition as well, two test pits have been sunk on the bank of the river, one at station 25 + 65 and one at station 33 + 00. It is in this immediate vicinity the greatest impediment to flow occurs in the River, and it appears that also at this point was deposited the largest proportion of the slide from Portage Creek, which at some distant time flowed into the River. These test pits have been carried down to a point below the projected new channel, and they indicate the presence of gravel and boulders, the boulders ranging in size up to 1000 pounds. These two test pits, in addition to information gleaned from the present River bed, would indicate that they are a fair sample of what may be expected along the entire portage.

In order to lower the level of Lillooet Lake, both at low water and at high water, we proposed to construct a channel 300 feet wide at the bottom with side slopes of two to one, with the bottom of channel at elevation 637 at Lillooet Lake and 631 at Tenasse Lake, both referred to the Geodetic Datum. This over its entire length of 6000 feet, will give a slope of 0.001 and will give the following elements for a carrying capacity of 28,800 c.f.s.

Slope	- .001 or 5.28 feet per mile
Bed Width	- 300 feet
Depth	- 10 feet
Area	- 3200 feet
W.P.	- 344.8 feet
R.	- 9.28
N.	- .0225
C	- 93.9
V	- 9.01 f.p.s.
Q	- 28,800 c.f.s.

October 19 - 12.5 feet of depth in channel will provide 5 feet of storage, or 20,000 c.f.s., leaving a balance of 40,200 c.f.s. to run away in channel. This will give the Lake an elevation of 649.5 feet.

October 20 - 12.5 feet of depth in channel will give a flow of 42,200 c.f.s. which would more than cover the amount coming into the Lake. Elevation would remain at 649.5 feet.

October 21 - 11.0 feet of depth in channel will provide a flow of 34,000 c.f.s. sufficient to take care of the inflow of 27,000 c.f.s. plus the draining away of $1\frac{1}{2}$ feet of storage in the Lake. This would bring the elevation of Lake down to 648.0 feet.

October 22 - 9.5 feet of depth in channel will provide a flow of 24,400 c.f.s. sufficient to take care of inflow of 18,080 c.f.s. plus the lowering of the Lake by another 1.5 feet Lillooet Lake would now have an elevation of 646.5 feet.

October 23 - 8.0 feet of depth in channel will provide a flow of 20,100 c.f.s. sufficient to take care of inflow of 12,710 c.f.s. plus the lowering of the Lake by another 1.5 feet. This will bring Lillooet Lake down to 645 feet.

It is impossible to predict the elevation of the Lake exactly. Two factors have not been included in the above, viz, the slope of Lillooet Lake or the effect of the level of Tenasse Lake. However when the two dams at the foot of Tenasse Lake are removed, we do not anticipate that this Lake will rise as fast as Lillooet Lake, which will give a larger slope between the two Lakes.

We anticipate that the effect of this proposed channel on Lillooet Lake will be to lower the low water by six feet and the High water by a minimum of 8 feet. We expect that the average high water will be reduced by 10 feet.

The lowering of the Lake will cause the same scouring of the North Lillooet up to the mouth of Birkenhead Creek. Thus it will also prevent the waters of the North Lillooet River from causing any flooding of this area.

It is not proposed at this time to block any entrance to the North Lillooet from the South Fork. The tendency will be for these

entrances to seal up gradually.

For other depths its discharge will be as follows:-

Depth	El. of Lillooet Lake	Q
4 feet	641	6,400 c.f.s.
6 feet	643	12,500 c.f.s.
8 feet	645	20,100 c.f.s.
10 feet	647	28,800 c.f.s.
12 feet	649	39,200 c.f.s.

The following is an estimate of the total runoff into Lillooet Lake in October 1940, during the period of the maximum flood recorded in the past 31 years.

	Lill. R. Records	Green R. Records	Birken-head R. (Est'd)	Other Creeks (Est'd)		Total
1940						
Oct. 16 -	3,400	700	350	350	=	4,800
17 -	3,340	2,000	1,000	1,000	=	7,340
18 -	17,100	7,390	3,700	3,700	=	31,190
19 -	31,800	14,200	7,100	7,100	=	60,200
20 -	23,600	8,830	4,415	4,415	=	41,260
21 -	15,400	5,800	2,900	2,900	=	27,000
22 -	11,100	3,490	1,745	1,745	=	18,080
23 -	6,710	3,000	1,500	1,500	=	12,710

As Lillooet Lake is approximately 15½ miles long and 3/4 mile wide, its area is approximately 8000 acres. Thus one foot of storage in the Lake takes care of 4000 cubic feet per second for 24 hours.

It is also proposed to clear away the two dams at the lower end of Tenasse Lake which are shown on plans. These dams consist of timber and boulders and were placed there during the time of the Cariboo Gold Rush to raise the waters of Tenasse Lake so that boats could ply to the upper end of Lillooet Lake.

The effect of a channel as indicated herein and as shown on the plans hereunto annexed, on the elevation of Lillooet Lake during a runoff similar to the one in October 1940 would be approximately as follows:

October 16 - 3 feet of depth in channel would carry away the runoff, giving an elevation of 640 feet.

October 17 - 4 feet of depth in channel would take care of runoff, giving an elevation of 641 feet.

October 18 - 7.5 feet of depth in channel will provide 3.5 feet of storage, or 14,000 c.f.s. leaving a balance of 17,190 c.f.s. which would be carried away in channel. This will give an elevation of Lake of 644.5 feet.

Estimated Cost of Proposed Channel etc. between Lakes Lillooet and Tenasse

591,830 cu.yds. excavation @ 50¢ per yd.	$295,915.00
Removal of Crib and Rock dams at lower end of Tenasse Lake	7,500.00
Clearing 50 acres of Portage @ $250.00 per acre	12,500.00
Re-routing Portage Creek	1,500.00
Grading and gravelling road from Rancherie to upper end of Lillooet Lake (6 miles @ $1000.00 per mile)	6,000.00
	$323,415.00
Contingencies and Engineering 10%	32,341.50
	$355,756.50

Note: It is assumed that the sale of timber on portion to be cleared will more than pay for stumpage dues and removal.

Lands benefitted

The following is a schedule of the lands which we consider will be reclaimed by the above works:-

Lake Front	140 acres
I.R. No. 3, Easterly Part	711 acres
Lot 98, Group 1 (Indian Reserve)	510 acres
Lot 99, Group 1 (Indian Reserve)	272 acres
I.R. No. 3, Westerly Part	260 acres
I.R. No. 1	180 acres
Lot 214	50 acres
I.R. No. 2	153 acres
Lot 209	200 acres
Lot 211	230 acres
Total	2706 acres
Indian Reserves	2106 acres
Privately owned & B.C. Govt.	600
	2706 acres

Cost per acre of Reclaimed Land

The cost per acre of land which will be reclaimed directly due to the lowering of the Lake will be $131.50 per acre. This land at the moment is not being used for agricultural purposes, nor can it in its present state so be used.

This is the cost when the total estimated cost has been charged to the land directly benefitted. However the effect of this lowering of the Lake will be felt far beyond this area, as the success of the proposed works farther above in Area No. 2 will depend in considerable degree on the lowering of the high water in Lillooet River at the mouth of Green River. Thus a certain proportion of this cost should be charged against lands in Area No. 2.

In any event the reclamation of 2706 acres of land at a price of $131.50 per acre appears to us to be worth while. The amount of such arable land in British Columbia is limited, and only occurs in our valleys. The benefits of this productivity to the District as well as to the Province are quite apparent, and we would recommend that these works designed for the lowering of Lillooet Lake should be undertaken.

Area No. 2

Area No. 2 comprises all the land lying South and West of the Lillooet River, lying between Green River on the South and Miller Creek on the North. The success of the reclamation of this area depends in a large measure on the degree of scouring of the bottom of Lillooet River below Green River due to the lowering of the high water level of Lillooet Lake. This scouring will have to be assisted where submerged logs or snags occur.

The proposed scheme of reclamation for Area No. 2 is as follows:-

1. Diversion of Outlet of Green River

At the present time the waters of Green River and Lillooet River nearly meet in headon collision. During low water there is no difficulty but when the freshet is on and the velocity of both streams is high, there is great confusion, a slackening of the velocity of both, and a hump of high water is created before the combined waters can escape. We would suggest that a diversion of the outlet of the Green River be made as shown on the plan. This will be 2800 feet long and will take the place of 5600 feet of river. On the basis of the present gradient of Lillooet River this will give a slope of 0.118 in the 2800 feet as opposed to 0.059 in its present channel. The two streams will also mingle without confusion and will not interfere with the velocity of either stream.

It is proposed to excavate a new channel 40 feet in width with an average depth of six feet. The greater velocity will shortly make a new channel for Green River to carry practically its full flow. The old channel will remain for overflow.

If the lowering of Lillooet Lake also lowers high water at the junction of these two rivers sufficiently, it would be worth while to open a new channel for Green River along a slough along the mountain, giving a new outlet on Lillooet River at least one mile below the present one.

2. Ditch along One Mile and Two Mile Creeks

It is proposed to dig a new ditch, from near Miller Creek to Green River, excavated to as constant a grade as possible, and utilizing where possible the present One Mile and Two Mile Creeks. This ditch will vary from 6 feet at the bottom above the Beaver Dam to 16 feet on the bottom from the highway to Green River. Its average depth will be four feet.

The lowering of high water at the mouth of Green River, caused by the lowering of the high water in the Lake and by the diversion, is quite vital to the proper functioning of this ditch in its lower reaches. Also this ditch, without feeder and side ditches will not be sufficient to completely drain the land through which is passes. It supplies the channel to which individual farmers can lead their own ditches from their high land.

3. Dyke along Lillooet River

A new dyke along the Lillooet River from Miller Creek to the mouth of Green River and thence along Green River to One Mile Creek is also proposed. This dyke with a top 6 feet wide and averaging four feet high, will be set far enough back from the River to allow for some erosion of the banks and to increase cross section of channel. This will prevent flooding by high water. We have hear no reports whatever of seepage from Lillooet River. We think this seepage comes from Miller Creek and the mountains.

4. Rip Rap and Brush along River

Where there appears to be erosion in the concave bends of the River the banks should be strengthened against high water by laying brush along them, and holding it in place with rock or stakes. Also all logs on bank, or in river should be taken out, and constant inspection

carried out to see no jams occur. Also any erosion should be immediately taken care of before the banks wash too much.

5. Cleaning out Miller Creek

Miller Creek, through the years has built up a heavy delta of rocks and gravel, so that it tends to flow to either side. This tendency and its attendant seepage is the chief cause of all the water in Area No. 2. This water keeps on moving South and East through choked up sloughs till it gets to Green River. It cannot possibly at any place get to the Lillooet, on account of high banks. We propose that the present channel of Miller Creek be deepened, straightened and cleaned out to make a new channel 60 feet wide and at least 5 feet deep. This will carry away at least 3500 c.f.s., and while it will not stop all seepage, it will considerably reduce it.

The following is an estimate of cost of the above work.

Diversion of outlet of Green River

Channel 40' x 6' x 2800' = 24,900 c.y. @ 20¢.....$ 4,980.00

Ditch along One Mile and Two Mile Creeks

Cleaning out Creek	- 3600 feet @ 1½ yds.	=	4,800 c.y.
New 16' Ditch	-10100 " @ 3 "	=	30,300 c.y.
New 14' Ditch	- 3300 " @ 2½ "	=	8,250 c.y.
New 12' Ditch	- 3500 " @ 2 "	=	7,000 c.y.
New 6' Ditch	- 5150 " @ 1 "	=	5,150 c.y.
			55,500 c.y. @ 20¢...11,100.00

Dyke along Lillooet River

Dyke from Miller Creek to Mouth of Green River, 32,000 feet @ 2 yds.	=	64,000 c.y.
Dyke along Green River 2400 feet @ 2 yds.	=	4,800 c.y.
		68,800 c.y. @ 25¢...17,200.00

Clearing along River with bulldozer, 45 acres @ $100.00 per acre...4,500.00

Clearing along Ditch, 7.5 acres @ $100.00 per acre..... 750.00

Rip Rap and Brush along River..... 3,500.00

Cleaning out Miller Creek, 4000 feet of Creek @ 11yds. per ft.
44,000 c.y. @ 20¢.....8,800.00

$ 50,830.00

10% for Engineering and Contingencies.....5,083.00

$ 55,913.00

Lands in Area No. 2 Benefitted by above Works

Lot 213	--	145 acres
Lot 204	--	240 "
Lot 203	--	200 "
Lot 165	--	245 "
Lot 202	--	65 "
Lot 164	--	350 "
Lot 166	--	315 "
Lot 201	--	260 "
Lot 188	--	180 "

2000 acres

Cost per Acre

The cost per acre of the above works is $27.96. The benefits derived should soon pay this cost.

We are confident that the work outlined for Area No. 2 will ensure reasonable reclamation. The River is fairly straight and well contained in this area. It is not known at present what extra ditches will be required to cope with seepage. Each area has its own coefficient. Also care must be taken to maintain the channel for Miller Creek. The whole District is large enough to have its own drag line shovel which can repair dykes, keep ditches and Miller Creek channel in good working order and dig new ditches.

We do strongly recommend though, that the work in Area No. 2 be not undertaken until the effect of lowering Lillooet Lake has been fully assessed. This effect will have considerable influence on the design of works in Area No. 2, both as to dyke and ditch.

Area No. 3

Area No. 3 comprises all the land West of the Lillooet River lying North of Miller Creek and South of the North Fork of Ryan Creek. This area includes the District called Pemberton Meadows, and is the most thickly settled and best improved area in the valley. The land produced some of the best potatoes and turnips in the district, yields of ten and twelve tons of potatoes per acre and 20 tons of turnips being average crops. The danger of overflow from Lillooet River has always been present, but the good farmer usually was able to gather in his crop as only the higher ground was utilized. Ryan Creek runs along the West side of the valley at a higher elevation than the most of the land. Thus we have a strip of land between the Lillooet River and Ryan Creek averaging from one-half to 3/4 miles in width, in which the high ground is close to the banks of the River and the Creek, and the intervening ground is three to four feet lower than the banks.

Of late years the water table has risen due to seepage and overflow from Ryan Creek. There appears to be very little seepage from Lillooet River as its banks are composed of fine silt closely resembling clay in its appearance. Many of the farmers now find it impossible to grow potatoes on land which formerly gave good crops, and have had to use the land for grazing. This does not give nearly

the returns formerly received, as there was and still is a great demand for Pemberton potatoes to be used as certified seed.

The works herein proposed for this area will not constitute complete reclamation but will certainly give considerable relief and should put this area in much better shape than it has ever been.

The works proposed are as follows:-

1. Dyke along the River

It is proposed to construct a dyke along Lillooet River from the North Fork of Ryan Creek to Station 30 + 60.2 in Lot 183 approximately 900 feet below the mouth of McKenzie cut. There is already along this section about 3300 feet of dyke. The new dyke will range in height from three to six feet. A proper core trench to stop seepage and to make a proper key with the ground will run its entire length. This will leave 28,700 feet of new dyke. There are occasional logs in the banks which should be cut out, and logs lodged on sand bars which should all be drawn on to the land away from channel. Provision is also made for protecting the banks on the outside of bends and curves on the West side of channel by means of brush, rock and stakes. Constant patrol up and down the River will be necessary to stop any incipient obstacles to flow or to protect any place where excessive scouring is taking place on the banks.

2. Dyke along Ryan Creek

It is also proposed to erect a small dyke along the East bank of Ryan Creek to do away with overflowing when the water is high. A deep core trench will be dug here and filled with clay to stop as much seepage under the dyke as possible.

3. Drainage Ditches

It is proposed to excavate ditches on property lines running East and West as shown on plan hereunto annexed. Each ditch will have a bottom width of four feet, with sides 1 to 1½ and graded to flow to Lillooet River. The depth at the banks of River will be from 6 to 7 feet. At the outlet of each ditch will be placed a flood box, of a size suitable to the flow, which will allow the water to run out but will prevent any water from running in.

Further study and experience may increase the number of these drains

needed and may also include interception ditches on the West which will catch seepage water from Ryan Creek. In some cases it may be found necessary to instal small individual pumps at the outlet to take care of excessive seepage when the water is running high.

4. Diversions

It is proposed to open up the McKenzie Cut as well as three smaller ones farther North. The effect of these is to keep the Lillooet River against the mountain on the East, giving it shorter length, fewer right angle bends, and thus greater volocity. It will then carry the water away to the Lake faster than it now does. This will eventually also bring more land available for agriculture into this area at a later date, although in this report this land has not been taken into account.

The following is the approximate length of these diversion:

	Length of Diversion	Length of Present River	Reduction in Length
McKenzie Cut	14,500 ft.	25,500 ft.	11,000 ft.
Lot 181 Cut	1,650 ft.	3,000 ft.	1,350 ft.
Fowler Cut	4,600 ft.	7,600 ft.	3,000 ft.
Lot 173 Cut	2,300 ft.	5,000 ft.	2,700 ft.
	23,050 ft.	41,100 ft.	18,050 ft.

It is recommended that these diversions be made in the same manner that the cut at the lower end of McKenzie Creek was made, that is by propagating powder. Most of the ground is much too wet to allow any machine to operate. The upper half of the McKenzie Cut has greater grade than the lower half. This will ensure that much of the silt will be deposited around McKenzie Lake, and will build up this low portion.

In the event that the work on Area No. 3 goes ahead, we would recommend that the McKenzie Cut be carried out first. The estimated cost of the work outlined above for Area No. 3 is as follows:

Dyke along Lillooet River, 28,700 ft. of dyke @ 1½ yds. per foot = 43050 c.y. @ 25¢.....	$ 10,762.50
Clearing strip for dyke 27 acres @ $150.00 per ac.....	4,050.00
Clearing log jams and pulling out logs.....	1,000.00
River protection 8700 ft. @ $1.00 per ft.....	8,700.00
Dyke along Ryan Creek, 28,500 ft. @ 1¼ yds. per ft. = 35625 c.y. @ 25¢.....	8,906.25
Clearing strip for dyke - 21.5 acres @ $150.00 per ac.....	3,225.00
Drainage - 31,500 ft. of ditch of 4' bottom width @ 1yd. per ft. = 31,500 c.y. @ 20¢.....	6,300.00
Diversions - 23,050 feet @ 50¢ per ft.....	11,525.00
	$ 56,468.75
10% Engineering and Contingencies.....	5,646.87
	$ 62,115.62

Acreage benefitted

The area that will be benefitted by the works herein outlined will be as follows:-

Area No. 3

Lot 184	--	45 acres
Lot 183	--	326 acres
Lot 1161	--	54 acres
Lot 1154	--	17 acres
Lot 182	--	387 acres
Lot 181	--	325 acres
Lot 180	--	213 acres
Lot 179	--	312 acres
Lot 177	--	265 acres
Lot 176	--	176 acres
		2120 acres

Cost per acre

The cost per acre of the land which will be directly benefitted by these proposed works, on the basis of $62,115.62 distributed over 2120 acres is $29.30 per acre. We are confident that the added returns from this land will more than make up this amount.

We do not believe that the works outlined herein for Area No. 3 will give complete reclamation, nor do we think that they will guarantee that no floods will ever occur. Both the Lillooet River and Ryan Creek are lusty streams and both demand great respect. All dyking districts, especially at the first are subject to the occasional flood until the weak spots are combed out. Even the older districts have an occasional flood. This Area will need constant patrol and attention.

We do think that the work outlined herein will prove to be a greater benefit than its cost, and that it should be done. It is the first step in any scheme looking to the reclamation of this area, and if something of this nature is not done soon, all of Area No. 3 will return to grazing land for cattle.

Area No. 4

This comprises all the land lying North of the North Fork of the Ryan Creek. This area consists of land which is approximately the same height as the average high water. The grade of Lillooet River is increasing in this area. It has been frequently changing channels. Drainage ditches will help. We think that for the moment this area should not be considered. We think that its treatment should be postponed until the experience gained from the River Area No. 3 can be used to design the protection for this area.

The total approximate area of No. 4 from the North boundary of Lot 176 to North boundary of Lot 168 is 1200 acres.

Soil Survey

We would recommend that a soil survey of the lower land be made to make sure that, when drained, it will be suitable for agriculture. The ridges along the River which are cultivated now, have been progen to be very productive. It would be wise to make certain the same soil continues along the lower levels, on the ground which is now wet all the time.

The following is a schedule of Plans accompanying this report:-

1. Plan of Area No. 1.....28723 G 12
2. Plan of Area No. 2.....28723 G 13
3. Plan of Area No. 3 and No. 4.....28723 G 14
4. Cross Sections of Lillooet River.....28723 G 11
5. Profile of Lillooet River and Tributary Streams.....28723 P 1
6. Plan and Profile of Lillooet River between Lillooet and Tenasse Lakes.....28723 B 1
7. Cross Sections of Lillooet River between Lillooet and Tenasse Lakes.....28723 B 2
8. Plan of Portage Creek Diversion.....28723 B 3
9. Plan of Tenasse Lake Narrows.....28723 B 4

Summary

Area No. 1

We recommend that Lillooet Lake be lowered by providing an adequate channel to Tenasse Lake. It is the first step in the reclamation of the Pemberton Valley.

Area No. 2

We recommend that, if the lowering of Lillooet Lake gives sufficient relief to high water at the junction of Lillooet and Green Rivers, the works outlined for Area No. 2 be carried out. If relief does not extend that far, then a change in design of these works, with a greater cost per acre will be necessary. The works proposed for this portion are in many ways similar to those proposed by Cleveland and Cameron in 1914.

Area No. 3

We recommend that the works outlined in Area No. 3 be carried out. While they do not promise complete reclamation, they are the first step in such reclamation, and unless something of this nature is done, the situation there due to flooding and seepage, will become worse and worse. McKenzie Cut Diversion should be made first.

Area No. 4

We recommend that the study of this area be postponed so that the experience gained in Area No. 3 may be available.

We recommend that a soil survey be made before Areas 1,2,3 and 4 are touched.

We beg to remain,

Yours very truly,

BURNETT & McGUGAN

Per:

BURNETT & McGUGAN
ENGINEERS & SURVEYORS
NEW WESTMINSTER, B.C.

INDEX FOR SNAPSHOTS

1. Farm scene at Pemberton Meadows in Area No. 3
2. House and Barn at Pemberton Meadows in Area No. 3
3. Ryan Creek above junction of North and South Forks February, 1945
4. Log jam at junction of North and South Forks Ryan Creek February, 1945
5. Hotel, Store, Post Office and Pemberton Express at Pemberton
6. Lot 164 (Mr. Shore) showing partially reclaimed and unreclaimed land.
7. House on Lot 164 (Mr. Shore) Area No. 2
8. Cultivated land on Lot 164, Area No. 2
9. Undeveloped land from point on road to Rancherie
10. View of mountains on West side of valley

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